130H-1

WOODWORKING

AG 130-H

UNIT OBJECTIVE

After completion of this unit, students will be able to measure, mark, cut, and assemble wood projects and operate woodworking tools safely. This knowledge will be demonstrated by completion of assignment sheets and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Select kinds, grades, and quantity of lumber for a given task.
2. Identify and demonstrate the uses of ten different woodworking hand tools.
3. Measure and mark wood for cutting and drilling.
4. Cut and assemble wood parts.
5. Know the basic joints used in woodworking and demonstrate the application of two.
6. Operate power tools correctly and safely, replacing blades and making adjustments as necessary.

130H-2

SELECTING WOOD AND LUMBER

A. Kinds of Wood

1. Softwood comes from needle-leaf, evergreen trees called conifers.

    a. White pine--which is easy to work with and straight--is used for shelving, interior finish, exterior trim, and door frames.
    b. Yellow pine--which is wear resistant and tough--is used for benches, stairs, and other places where a semi-hard surface is desired.
    c. Fir--which is light, straight, and strong--is used for framing members (dimension lumber), siding, sheathing, and gates.
    d. Redwood--which has excellent decay resistance--is used for posts, fences, patios, and siding.
    e. Cedar--which is light and easy to split--is used for fence posts, sills, and shingles.
    f. Spruce--which is light, straight, strong, and resonant--is used for aviation and musical instruments.

2. Hardwood comes form broad-leaf trees that lose their leaves each fall season, called deciduous trees.

    a. Oak--which is tough, strong and open-grained--is used for floors, interior finish, barrels, and furniture.
    b. Walnut--which has a beautiful, brown, open grain--is used for fine furniture.
    c. Maple--which is a very durable and light-grained--is used for floors, interior finish, furniture, and guitar necks.
    d. Mahogany--which is reddish in color--is used for fine furniture.
    e. Birch is used for surface veneer on cabinets and doors.

B. Log Cutting Methods and Lumber Finishes

1. Cutting Methods

    a. Slash sawing cuts a log so that the annular rings form an angle of less than 45 degrees with the surface of the lumber.

        1) Softwood lumber cut in this fashion is referred to as flat-grained.
        2) Hardwood lumber cut in this fashion is referred to as plain-sawed.

b. Quarter sawing cuts a log so that the annular rings form an angle of more than 45 degrees with the surface of the lumber.

1) Softwood lumber cut in this fashion is referred too as edge-grained.
2) Hardwood lumber cut in this fashion is referred too as quarter-sawed.

2. Finishes

a. Rough lumber comes directly from the sawmill unplaned and varying in dimensions from piece to piece.
b. S2S is lumber surfaced on two sides allowing all pieces to have the same thickness, but varying widths.
c. S4S is lumber surfaced on four sides allowing exact dimension from piece to piece. The actual sizes are 1/2 inch less than the nominal sizes; for example, the actual size of a 2 x 4 is only 1 1/2" x 3 1/2."

C. Kinds of Lumber and Wood Panels

1. Wood cut into uniform thickness, width, and length is called lumber.

a. Boards are lumber used for flooring, sheathing, paneling, and trim.
b. Dimension lumber is used for sills, plates, studs, rafters, and other framing members.
c. Timbers are lumber used for posts, beams, and heavy stringers.

2. Wood panels (usually 4' x 8') are made through various methods.

a. Plywood consists of thin layers of wood glued together with the wood grain turned at right angles in each successive layer.
b. Composite board consists of a core of wood fibers bonded on either side with veneer.
c. Hardboard consists of refined wood fibers pressed together to form a hard, dense material (55 - 75 lb. per cu. ft.).
d. Particle board consists of wood flakes, chips, and shavings bonded together with resins or adhesives to form a less dense material (42,45, or 47 per cu. ft.).
e. Waferboard consists of high quality flakes of wood (about 1 1/2 inch square) bonded together under heat and pressure with the waterproof adhesive, phenolic resin.

f. Oriented strand board is similar to wafferboard in appearance, but consists of wood fibers bonded together in successive layers arranged at right angles to one another.

D. Grades

1. The Basis of Lumber Grades

a. Lumber grades are based on the appearance and soundness of the wood.
b. The fewer and less obvious the defects, the more the lumber costs.

1) A lumber defect is an irregularity in or on the wood that reduces its strength, durability, or usefulness.
2) A lumber blemish is a defect that impairs only the wood's appearance.

c. The common lumber defects include the following:

1) Knots are embedded branches or limbs in the lumber.
2) Holes can be caused by mishandling or insects and worms.
3) Splits and checks are separations of the wood fibers along the grain and across annular growth rings.
4) Shakes are separations of wood fibers along the grain and between annular growth rings.
5) Pitch pockets are cavities that contain or have contained liquid or solid pitch.
6) Honeycombing is the separation of wood fibers inside the lumber, which may not be visible on the surface.
7) Wane is the presence of bark or the absence of wood along a board's edge.
8) Decay is the disintegration of wood fibers caused by fungi.
9) Blue stain is the discoloration caused by any of various fungi (as of the genera Ceratostomella, Penicillium, or Fusarium)
10) Warp is any variation from a plane surface, including cups, bows, crooks, and twists.

2. Basic Lumber Grades

a. Select refers to lumber of good appearance and finishing qualities.

1) Grades A and B are suitable for natural finishes.
2) Grades C and D are suitable for paint finishes.

b. Common refers to lumber containing defects and blemishes.

1) Common no. 1, 2, and 3 are suitable for use without waste.
2) Common no. 4 and 5 are suitable for use permitting waste.

3. Plywood Grades

a. A grade lettering system is used to indicate the quality of the veneer used on the face and back of the panel.

1) N is a veneer with a smooth surface suitable for natural finishes.
2) A is a veneer with a smooth surface suitable for painting.
3) B is a veneer with a solid surface.
4) C Plugged is an improved C veneer with splits limited to 1/8 inch width, and knotholes and bore holes limited to 1/4 x 1/2 inch.
5) C is a veneer with tight knots to 1 1/2 inch.
6) D is a veneer with knots and knotholes to 2 1/2 inch width across the grain which is limited to interior, Exposure 1 and 2 panels.
7) G2S means the veneer is good on two sides.
8) G1S means the veneer is good on only one side.

b. Mills which are members of the American Plywood Association (APA) indicate the panel's intended use or performance rating with an APA trademark stamp, which includes the following information:

1) Panel grade indicates its use, such as sheathing.
2) Span rating is indicated by a pair of numbers separated by a slash, such as 32/16.

a) The 32 indicates the maximum recommended span in inches when used as roof sheathing.
b) The 16 indicates the maximum recommended span in inches when used as subflooring.

3) Thickness in inches (common sizes being 1/4, 3/8, 1/2, 5/8, and 3/4).
4) Exposure durability classification is indicated by three names:

a) Exterior is bonded with a 100% waterproof glue allowing it to be used outdoors and continually exposed to moisture.
b) Exposure 1 is interior plywood that can be exposed to moisture for extended periods.
c) Exposure 2 is interior plywood that can withstand some leakage or high humidity for short periods.

E. Factors to Consider When Selecting Lumber

1. Quality construction does not require that all the lumber be of the best grade.
2. Several grades of lumber may be appropriate in a single structure.
3. Good economical construction requires the proper use of the lowest grade lumber suitable for the purpose.

ACTIVITY:

1. Practice identifying different kinds of wood.
2. Practice identifying different kinds of lumber and wood panels.
3. Practice identifying wood defects.
4. Practice identifying lumber and plywood grades.
5. Select lumber and wood panels for an ongoing project, such as a toolbox or sawhorse.

MEASURING AND MARKING WOOD

A. Measuring and Marking Vocabulary

1. Straight - an adjective describing a line that is the shortest distance between two points
2. Square - an adjective describing lines, surfaces, or planes positioned at right angles (90 degrees) to one another

3. Perpendicular - an adjective describing a line, surface, or plane that is positioned at a right angle to another line, surface, or plane
4. Level - an adjective describing a line, surface, or plane lying parallel to the plane of the horizon (axis or the earth) having the same height everywhere
5. Plumb - an adjective describing a line, surface, or plane that is exactly vertical or true
6. Flush - an adjective describing the positioning of two or more objects so that their edges, surfaces, or ends are even, level, or on the same plane
7. Bevel - a sloping edge (less than 90 degrees)
8. Miter - a term usually referring to a 45 degree angle
9. Working edge or surface - the main edge or surface from which the other surfaces are measured or squared

A. Using a Tape Measure to Measure and Mark Wood:

1. Measuring the Distance between Two Points:

a. Place the end of the tape precisely on the first point.

1) The hook on the end of most tapes slides a distance equal to the thickness of the hook in order to provide accurate measurements whether it is hooked onto the end or edge of a board or pushed against a surface.
2) If the hook is damaged or missing, start the measurement at the one inch graduation line and subtract one inch from tape reading.

b. Extend the tape to the second point.

1) Make sure all slack is taken out of the tape between the two points, or the resulting reading will be too long.
2) Make sure the tape is flush with the edge of the board being measured. If the tape angles even slightly across the board, the reading will be too long.

c. Read the tape at the graduation line on or nearest the second point (See section 130C, Measuring).

1) Long tapes are slightly arched across their width so they will remain fairly rigid while being extended; therefore, make sure the edge of the tape touches the wood if a very exact reading is required.

2) If measuring the distance between two inside surfaces, push the tape hook against one side and the tape case against the other, then read the graduation line nearest the tape case and add the length of the case to the reading.

2. Marking Wood for Cutting

a. To lay off a measurement on a board, attach the tape hook to the end of the board or place the one inch graduation precisely at the beginning mark and mark the board with a sharpened pencil at the desired graduation line on the tape.

1) When laying off several measurements in a straight line along a board, do not raise or move the tape until all the measurements are marked.
2) If the tape is raised and moved for each measurement, the possibility of errors is greatly increased.

b. To quickly and easily locate the middle of a board when the total width is a difficult-to-divide number (for example, 2 5/8" or 11 13/16"), lay a measuring tape across the board at any angle necessary to make full inch marks on the tape line up with both edges of the board. Then mark on the board the halfway point along the tape that is between the two edges of the board.

1) Do this at both ends of the board, then connect the two marks with the help of a straight edge or gauge.
2) This procedure can also be used to divide a board into three or more equal widths.

B. Using Squares to Measure and Mark Wood

1. Using a Carpenter's Square (Framing Square)

a. To mark boards to be sawed square (90 degrees to the working edge), use the following steps:

1) Measure and mark the desired length of the board.
2) Place the body of the square firmly against the working edge of the board.
3) Move the square until the inside edge of the tongue is against the length mark.

4) Holding a sharp pencil against the edge of the tongue, draw a thin line through the length mark and across the board.

b. To mark boards to be sawed at the same angle, use the following steps:

1) Position the square with the outside edge of the tongue along the angle cut in the end of the board to be duplicated.
2) Record the readings where both the tongue and the body meet the edge of the board.
3) Position the square on the board to be marked with so that the same two readings meet the edge of the board.
4) Holding a sharp pencil against the edge of the tongue, draw a thin line across the board, which will be the same angle as the original board.

2. Using a Combination Square

a. As a ruler, it can be used to measure distances up to 12 inches.
b. As a straight edge, it can be used as a guide for marking straight lines between points.
c. As a try square, it can be used for both marking and checking angles on wood.

1) It can be used as a guide to draw both 90 degree and 45 degree lines across the face, edge, or ends of boards.

a) To mark a 90 degree angle, extend the blade from the 90 degree shoulder, and place that shoulder firmly against the working edge from which the other surfaces are to be measured or squared.
b) To mark a 45 degree angle, extend the blade from the 45 degree shoulder, and place the shoulder firmly against the working edge.

2) It can be used to check the exactness of a right angle or miter angle cut by placing the appropriate shoulder firmly against the working edge and attempting to line up the blade with the cut.

d. As a marking gauge, it can be used for marking lines parallel to the edge of a board.

1) Extend the blade the desired distance from the 90 degree shoulder.
2) Move the 90 degree shoulder along the edge while marking the wood with a pencil held against the end of the blade.

e. As a depth gauge, it can be used to measure the depth of a dado or rabbet.
f. As a level, it can be used to level or plumb an object.

3. Using the Sliding T-bevel Square

a. It can be used to mark angles or bevels on wood.

1) The adjustable blade can be set to the desired angle by several methods.

a) Place the handle against the working edge of the board and adjust the blade so that it fits the angle marked or cut across the board.
b) Or, the angle can be set using a protractor if the degrees are known.

2) The bevel square set to the desired angle is then used as other squares are to mark off the angle.

b. It can be used to check angles cut in wood.

1) Place the handle against the working edge of the board and adjust the blade so that it fits the angle cut across the board.
2) Place the handle against the base of a protractor and note the reading where the adjusted blade meets the arch.

C. Using Chalk Lines, Plumb Lines, and Levels to Mark and Check Wood

1. Using a Chalk Line to Mark Wood

a. Stretch a strong cotton or nylon string coated with colored chalk between the two points meant to be joined by a straight line.
b. Lift the line midway between the two points and allow it to snap back into place.
c. Remove the chalk line and a straight mark will be left.

2. Using a Plumb Line to Mark Wood

    a. It can be used to locate a point directly below another.

        1) Tie the plumb line to a nail in the point desired and allow the plumb bob to come to rest.
        2) Mark the wood directly below the point of the plumb bob.

    b. It can be used with a carpenter's square to mark a level line.

        1) Suspend the plumb line and allow the plumb to come to rest.
        2) Align the body of the square with the plumb line.
        3) Mark the level line with a sharp pencil along the edge of the tongue of the square.

3. Using a Level to Mark Wood

    a. To make a level mark on a vertical surface, position the level against the surface so that the bubble in the middle tube is centered, then mark a line with a sharp pencil along the edge of the level.
    b. To make a plumb mark on a vertical surface, position the level against the surface so that the bubble in the tube located near the end of the level is centered, then mark a line with a sharp pencil along the edge of the level.

ACTIVITY:

1. Practice using a measuring tape to measure and mark wood for cutting.
2. Practice using squares to measure and mark wood for cutting.
3. Practice using a chalk line, plumb line, and level to mark wood for cutting.
4. Measure and mark wood to be cut for an ongoing wood project, such as a toolbox or sawhorse.

WOODWOEKING HAND TOOLS

SAFETY IN CARPENTRY WORK

Observe the following general safety practices in doing all carpentry work.

1. Wear industrial-quality safety glasses. When the work has the possibility for eye injury, be sure to wear safety glasses. Safety glasses should have the Z87.1 log on them to assure they are industrial quality.
2. Wear safety-toed shoes. When handling heavy carpentry materials, wear safety-toed shoes to protect your feet and toes.
3. When handling carpentry materials, wear a hard flat hat or a bump cap to protect the head.
4. When handling rough carpentry materials, wear gloves.
5. When painting, insulating, or working in dusty conditions, always wear an appropriate-type respirator.
6. Work clothing should not be loose, baggy, or highly flammable. The big danger is getting loose clothing caught in power machinery. Synthetic clothing is subject to low flashpoints, which may result in severe burns. When working on carpentry jobs, avoid wearing such clothing.
7. Use correct hand tools for each job. Hold each tool correctly and use it properly.
8. Lift and carry heavy objects correctly. When lifting a heavy object, stand close to the object, bend your legs to pick up the object, then lift with your legs, not your back.
9. Work defensively to avoid falls and falling objects.
10. Practice good fire safety where fire hazards exist. Use the appropriate type of extinguisher if a fire should occur: Type A extinguishes wood and paper fires; Type B extinguishes gasoline, oils, and paint fires; and Type C extinguishes electrical fires.
11. Remove protruding nails from unused lumber. Prevent puncture injuries by removing nail hazards.

SAFETY IN HAND AND PORTABLE POWER TOOL WOODWORKING

SAFETY PRACTICES FOR USING HAND TOOLS

The following are general safety practices for using hand tools.

1. Secure the work. Always use a clamp, a vise, or some means to hold the work. Securing the work prevents it from slipping and frees both hands to hold tools.
2. Store tools properly. When tools are not in use, store them safely. Store all sharp-edged cutting tools with the sharp edges down.

3. Keep tools clean. Keep all hand woodworking tools clean and free of oil and grease so they will not slip when in use.
4. Inspect tools before using. Tools that damaged or have broken handles should be marked unsafe. Do not use them until they have been repaired.
5. Use the correct tool for the job. Use each hand woodworking tool only for the job for which it was designed. Forcing a small tool to do the job of a large one may result in injury or tool damage.
6. Grip tools firmly. Hold hand woodworking tools--especially the hammer and wrenching bar--securely so that they do not slip and hit someone. Hold tools such as the plane with both hands. Do not wear gloves-they are bulky and make gripping tools difficult.
7. Use the correct hammer. Never use a machinist's hammer in place of a carpenter's hammer. Do not strike a hardened steel surface, such as an anvil, with a steel hammer because a small piece of steel may break off and injure someone.
8. Avoid hammers with damaged handles. Do not use hammers with broken or split handles. Make sure the handle fits tightly in the hammer head.
9. Stand in a safe location. When using a hammer or a hatchet, do not let anyone stand directly in line with the tool's path of movement.
10. Hold nails tightly. When starting a nail, hold it tightly so that it will not fly loose and hit someone.
11. Remove nails. Before using any cutting tool--including saws, wood chisels, plains, and drills--remove nails or other objects that might destroy the tool's cutting edge.
12. Keep cutting tools sharp. Sharp tools insure the best results and the safest operation.
13. Cut away from the body. When using tools with sharp edges, always cut away from the body.
14. Use the correct screw driver. Be sure the screw-driver bit fits properly in the screw slot to prevent it from slipping and causing injury.
15. Avoid checking circuits with screw drivers. Never use a screw driver to see if electrical circuits are hot.
16. Be careful when gluing. Read labels on containers to check for harmful fumes and highly flammable glues.

SAFETY PRACTICES FOR USING PORTABLE POWER TOOLS

The following are general safety practices for using portable power tools.

1. Obtain the instructor's permission. Obtain permission before using any portable power tool.
2. Protect your eyes and face. When using portable power tools, wear industrial-quality safety glasses or a safety shield.
3. Wear proper clothing. Do not wear loose-fitting clothing or jewelry that can get caught in moving parts. Do not roll up long sleeves.

4. Protect your hair and scalp. Pull back long hair in a band or a cap to keep it from getting caught in tools.
5. Know the tool. Read the operator's manual to learn the tool's applications and limitations as well as its potential hazards.
6. Use a respirator. Use a filter-type respirator in dusty conditions.
7. Avoid electrical shock. Be sure each tool has a three-blade grounding-type plug or is double insulated. Avoid using power tools in damp or wet places without standing on a dry board. Wear rubber gloves and boots for outdoor jobs.
8. Keep the work area clean. Keep the floor free of scraps and oil. Cluttered work areas and benches invite accidents.
9. Work only at operating speed. Do not use a power tool before it has reached operating speed or while it is coming to a stop. Never force a tool by applying too much pressure.
10. Never stop moving parts abruptly. Once a tool has been turned off, allow it to coast to a stop. Never force the tool into stock to stop it. Be sure the tool has come to a complete stop before laying it down.
11. Unplug tools properly. Unplug each tool from the power source after use and when you service or change accessories in a safe place when not in use.
12. Store unused accessories. Store tools and accessories in a safe place when not in use.
13. Use both hands. Use both hands to hold and guide saws and drills.
14. Stand in a safe location. To avoid being hit if the tool kicks back, do not stand directly behind the equipment.

A. Using Hand Saws

1. Crosscut Saw

a. A crosscut saw is used to cut across the grain of a board and can be identified by its teeth, which are filed to a point.
b. To cut across the grain of a board, perform the following steps:

1) If right-handed, grasp the handle with the right hand with the index finger extended along the side of the handle, which helps to guide the saw more accurately.
2) Position your body to the work so that your shoulders form an angle of about 45 to 60 degrees to the sawing direction, and your saw, right arm, elbow, shoulder, and eye are all in the same vertical plane.
3) Place the left knee on the board to hold it firmly on the sawhorses.
4) Grasp the far edge of the board with the left hand and use the thumbnail against the against the saw blade as a guide to start the cut.
5) Place the heel of the saw beside the line on the waste side and start the cut by making several backstrokes, lifting the saw on the forward strokes.
6) After the cut is started, push the saw forward while applying light, downward pressure at a 45 degree angle to the surface of the board.
7) Complete the cut using long, easy strokes without pressure on the return strokes, since the saw is designed to cut on the forward stroke only.
8) If the saw tends to go off course, twist the handle slightly while sawing to make it come back to the line gradually.
9) If the saw tends to get off square, bend the blade slightly while sawing to straighten it.
10) To finish the cut without splintering the board, complete the last few strokes slowing and without pressure on the saw while holding up the other end of the board.

2. Rip Saw

a. A rip saw is used to cut along the length of the board (with the grain) and can be identified by its teeth, which are filed to a knifelike edge and number fewer per inch than a crosscut saw.

b. To cut a board along its length with a rip saw, perform the above steps, but operate the saw at 60 degrees to the surface of the board instead of 45 degrees.

3. Back Saw

a. A back saw is used with or without a miter box to make very accurate angle cuts in narrow boards and can be identified by it rigid metal back and very fine teeth.
b. To make an accurate cross cut, perform the same steps as used with a crosscut saw or use a wooden miter box or adjustable miter box to help hold the board and guide the saw when cutting angles.

4. Coping Saw

a. A coping saw is used to cut large holes and irregular, curved cuts in thin wood, and can be identified by its thin, narrow, removable blade supported by a spring steel frame.
b. To cut large holes or other shapes in thin wood panels or boards, perform the following steps:

1) Drill a starter hole next to the line through the waste wood.
2) Remove the blade from the frame; insert it into the hole, and reattach it to the frame so that it cuts on the pull stroke, and is less apt to kink or break.
3) Secure the wood in a vise or hold it level on a work bench allowing it to project over the bench top.
4) Cut out the shape with long, steady, moderately slow strokes with the cut being made on the pull or downstroke depending on the position of the wood.
5) Cut as far as the frame will allow, then turn the blade a quarter turn in the frame and continue to saw until the frame stops the cut again.

5. Compass and Keyhole Saw

a. A compass saw and a keyhole saw are used to cut wood start in from a hole in the wood, and can be identified by their narrow, tapered blade and pistol grip handle.
b. To make straight and curved cuts in wood panels and boards with these saws, perform the following steps:

1) Bore a 1-inch starter hole next to the line in the waste wood with an auger bit.
2) Secure the wood in a vise and insert the blade in the starter hole.
3) Cut along the line with the cutting edge perpendicular to the wood surface, not at angles as with crosscut and ripsaws.
4) When cutting sharp curves, use short strokes with the narrow end of the blade.
5) Since these saws do not leave smooth surfaces when cutting sharp curves, do not try to cut exactly to the line, but leave about 1/16 inch to be removed with a file or spokeshave.

B. Using Boring and Drilling Tools

1. Bit Brace

a. A bit brace is a large crank-type handle used to turn auger bits, expansive bits, twist drills, spade bits, forstner bits, countersinks, and reamers for boring holes (1/4 to 2 inches) in wood.
b. To use a bit brace to bore wood with an auger bit, perform the following steps:

1) To start the auger bit on the mark or center hole, guide the bit point with one hand, knuckles down against the wood, and exert slight pressure on the head of the brace with the other hand.
2) While maintaining pressure on the brace head, turn the brace handle with the free hand keeping the bit perpendicular to the surface.
3) Check to make certain the auger bit is boring square by sighting from two directions or by using a square against the bit and the surface.
4) Lean on the top of the brace slightly to change the direction of the boring if it is not square.
5) To prevent splintering when boring entirely through a board, stop when the point of the bit starts to poke through, then turn the board over and finish the bore from that side.

2. Hand Drill

a. A hand drill is a tool with gears that turn a bit much faster than its handle turns, but with reduced turning power allowing it to drill holes only up to 1/4 inch diameter in wood.
b. To drill holes in wood with a hand drill, perform the following steps:

1) Place the bit on the mark perpendicular to the surface; push with a light, even pressure against the handle, and turn the crank with a steady, moderate speed.
2) A wooden dowel can be placed on the bit as a depth gauge if holes of uniform depth are required.
3) When drilling entirely through a board, release some of the pressure on the bit as it starts to break through to prevent splintering.

3. Push Drill

a. A push drill, or automatic drill, is used for rapidly drilling holes (up to 3/16 inch) for installing screws, and is identified by its spring-loaded, spiral-shaped shaft that turns clockwise when the handle is pushed down.
b. To drill screw starter holes in wood with a push drill, perform the following steps:

1) Place the bit on the mark perpendicular to the surface of the wood.
2) Push on the handle with one hand to impart a forward rotary motion to the bit.
3) Release the pressure on the handle allowing it to extend, imparting a backward rotary motion to the drill bit.
4) Pull the bit out of the hole when the hole is the desired depth.

C. Using Shaping Tools

1. Plane

a. A plane is used to shave wood in order to obtain a smooth surface, and comes in different lengths.
b. To adjust a plane, perform the following steps:

1) Turn the plane upside down and sight along the bottom of the plane from front to rear to verify that the blade is projecting through evenly and no more than 1/32 inch.
2) If adjustments are required, turn the depth-adjusting nut until the blade projects about 1/32 inch, and move the lateral adjusting lever until the blade extends through the throat evenly at both corners.
3) Make a trial cut and readjust the plane, if necessary, until it cuts smoothly and produces a thin, semi-transparent curl of wood with each stroke.

c. To plane a wood surface, perform the following steps:

1) Secure the board on the bench and stand to the left of the work with feet apart and with the left foot slightly forward.
2) Hold the plane with the left hand, palm down, on the knob and the right hand grasping the handle.
3) Plane with the grain of the wood from one end of the board to the other end without stopping.
4) At the beginning of each stroke, press down hard on the knob, and as you push the plane forward gradually shift more weight to the left foot.
5) Toward the end of each stroke, reduce the pressure on the knob and press down hard on the handle.
6) Always lay the plane on its side when the job is over in order to keep the cutting edge from being dulled.
7) Check the board with a straight edge.

2. Chisel

a. A chisel is used to shave wood in recessed areas, and is available in widths ranging from 1/8 to 2 inches.
b. To chisel wood with the grain, perform the following steps:

1) If possible, secure the wood in a vise in order to leave both hands free to use the chisel.
2) Guide the chisel with the left hand, and push the handle forward with the right hand.
3) Always keep both hands behind the cutting edge and push the chisel away from you.
4) To make the chisel blade cut easier, give it an oblique cutting edge by holding the handle slightly to one side, or by moving the handle from side to side.

5) Push the chisel with the bevel down for rough cuts and with the bevel up for finishing cuts.

c. To chisel wood across the grain, perform the following steps:

1) Push the chisel with the bevel up, except on wide boards where the chisel cannot reach the center.
2) Raise the handle just enough to make the blade cut.
3) To avoid splintering the edges, cut across the board partway from one side and partway from the other side.
4) A mallet may be used to drive the chisel for heavy chiseling or roughing cuts.

3. File

a. A file is used to smooth edges and shape wood to odd shapes, and may be flat, half-round, round, square, or triangular.
b. To dress down and smooth rough cuts on boards, perform the following steps:

1) A file with a sharp tang should never be used without a handle. Install a handle if necessary.
2) Hold the file handle in the right hand and guide the file with the left hand.
3) Push the file lengthwise along the board, never across the edge of the board.
4) Since the file teeth cut only when pushed forward, apply pressure on the forward stroke only.
5) Lift the file off the wood on the return stroke.
6) If the file teeth become clogged with sawdust, clean them with a wire brush or file card.

ACTIVITY:

1. Practice cutting, drilling, and shaping wood with ten different hand tools.
2. Cut, drill, and shape wood to be used in an ongoing wood project, such as a toolbox or sawhorse.

130H-21

WOODWORKING POWER TOOLS

SAFETY IN POWER WOODWORKING

Safety Practices for Using Stationary Power Tools

The following are general safety practices for using all stationary power tools.

1. Obtain the instructor's permission. Obtain instructor's permission before you use any stationary power tool.
2. Wear proper clothing. Do not wear loose-fitting clothing or jewelry that can get caught in moving parts. Do not wear gloves. Do not roll up long sleeves.
3. Protect your scalp and hair. Pull back long hair in a band or a cap to keep it from getting caught in moving machine parts.
4. Keep guards in place. Guards cannot protect you if they are not in place and in proper working order.
5. Avoid shock. Be sure that equipment is properly grounded. Do not use power tools in a damp or wet place without standing on a rubber mat.
6. Keep the work area clean. Keep the floor free of sawdust, grease, oil, and scraps. Cluttered work areas and benches invite accidents.
7. Unplug the machine. The electrical service to each machine must be disconnected when it is not in use, while it is being serviced, and when the accessories are being changed.
8. Work only at operating speed. Do not use a power tool before it has reached operating speed or while it is coasting to a stop.

TABLE SAWS

Safety Practices for Using Table Saws

Before studying the specific safety practices for using table saws, review the general safety practices for using stationary power tools.

1. Do not roll up long sleeves. Do not wear loose fitting clothing such as coats and ties.
2. When operating the table saw, do not wear gloves. Gloves are bulky and may easily be caught on parts of the table saw, thus creating an additional safety hazard.
3. Remove rings, bracelets, and other loose-fitting jewelry which have the potential of getting caught on the saw or materials.
4. Check the saw blade periodically for broken teeth and cracks.
5. When operating the table saw, stand to one side of the saw blade.
6. Make certain the blade guard, splitter, and anti-kickback device are used for all possible sawing operations.

7. Never reach over the saw blade to remove or hold down a piece of stock.
8. Avoid awkward work positions that may result in slips and contact with the saw blade.
9. Never raise the saw blade more than 1/4" above the material being cut. Lower the blade below the table top before you leave the work area.
10. Do not attempt to rip round or irregularly shaped stock on the table saw.

A. Portable Circular Saw

1. Purpose and Parts Identification:

a. The portable circular saw is an electric handsaw with a round blade used for making freehand cross, rip, miter, and bevel cuts in lumber and in assembled woodwork.
b. Its parts and their purposes are as follows:

1) The handle allows the operator to hold onto the saw.
2) The safety switch controls the power to the saw's motor.
3) The motor converts electrical power into rotary motion.
4) The power cord supplies electrical power to the motor.
5) The shoe or base rests on the wood being cut.
6) The upper guard protects the operator's body from the top of the saw blade.
7) The telescoping guard protects the operator's fingers from the bottom of the blade.
8) The depth adjustment controls blade depth below the shoe.
9) The tilt adjustment tilts the shoe to control blade angle.
10) The arbor shaft supports and rotates the blade.
11) The circular blade cuts the wood.

a) Rough cut combination
b) Crosscut
c) Rip
d) Standard combination or miter

2. Safe Adjustment and Operation Procedures for Portable Circular Saw

a. Always plug the saw's cord into a grounded outlet, and keep the cord clear of the blade.
b. Adjust the depth of the blade so that it extends about 1/8 inch (approximately the depth of one tooth)beyond the thickness of the wood being cut.
c. Check both the depth and angle adjustments to insure that they are tight.
d. Before turning on the switch, rest the saw base firmly on the wood with the blade clear to turn freely.
e. While cutting the wood, stand to one side of the cutting line, and keep the free hand away from the cutting direction and from underneath the wood.
f. If the portable circular saw has two handles, keep both hands on them while cutting the wood.
g. Always make sure the wood is well-supported so that the kerf does not close and bind the blade while cutting.
h. Provide support for thin wood near the cutting line, and secure small pieces to a benchtop or sawhorse with clamps.
i. Be alert while cutting in order to avoid cutting into sawhorses or other supports.
j. Never use a blade that is dull or out of condition.
k. Always stop and unplug the saw before changing blades or making adjustments.

A. Table Saw (Stationary Circular Saw)

1. Purpose and Parts Identification:

a. The table saw is a stationary circular saw (round blade) mounted in a table, which is used primarily for rip cutting wood. It can also do ripping, beveling, mitering, dadoing, etc.
b. Its parts and their purposes are as follows:

1) The body houses the table saw parts.
2) The safety switch controls the electrical power to the motor.
3) The table provides the work area.
4) The circular blade cuts the wood.
5) The blade guard protects fingers from the blade.
6) The saw height wheel is the front wheel that adjusts the height of the blade above the table.
7) The arbor tilt wheel is the side wheel that adjusts the blade tilt angle.

8) The ripping fence guides the wood when making rip cuts.
9) The miter gauge guides the wood when making crosscuts.

2. Safe Adjustment and Operation Procedures for Table Saw

a. Always obtain permission from the instructor before operating the saw.
b. Use only saw blades that are sharp and properly set.
c. During setup, make sure the blade is tightly fastened to the arbor with its teeth pointing towards the operator and able to spin freely.
d. Make sure the saw guard, splitter guard, and kickback teeth are in place and use them whenever possible.
e. Adjust the blade so that it extends 1/8 to 1/4 inch (approximately the length of one tooth) above the wood to be cut.
f. Always hold the wood against the ripping fence or miter gauge when cutting, never freehanded.
g. Before using the ripping fence, make sure that it is locked into position at the proper distance from the blade.
h. Never use the ripping fence as a guide for crosscutting, or kickback may occur.
i. Before using the miter gauge, make sure it slides freely down the entire length of the slot.
j. When using the miter gauge, hold the wood firmly against it and down on the table.
k. Stand to one side of the spinning saw blade to avoid kickback, and never reach over it.
l. Tail off when cutting long or bulky material, but do not push or pull the wood through.
m. Always keep a 4-inch margin between fingers and the blade, and use a push stick when ripping narrow pieces.
n. Always push the wood clear of the blade before releasing it.
o. Never try to cut warped or rough lumber on the saw.
p. Stop and disconnect the saw before making adjustments.
q. When the cut is complete, turn off the switch and remain by the saw until the blade has stopped.

B. Radial Arm Saw

1. Purpose and Parts Identification

a. The radial arm saw is a motor and circular blade supported by an overhead arm that is primarily used for crosscutting long lumber on a stationary table. It differs from the table saw in that the wood is usually held stationary while the blade is moved. Like the table saw, it can also be used for mitering, beveling, dadoing, and ripping but it is not as accurate as the table saw.
b. Its parts and their purposes are as follows:

1) The overarm supports the motor and blade over the table and allows them to cut miters and move back and forth.
2) The safety switch controls the electrical power to the motor.
3) The miter scale indicates the miter angle of the overarm.
4) The elevating crank raises and lowers the blade.
5) The column supports the overarm and saw.
6) The yoke supports the motor and blade over the table and allows them to turn parallel to the fence to rip wood.
7) The handle pulls the blade into the wood to make the cut.
8) The upper guard protects the operator's body from the spinning blade.
9) The lower guard protects fingers from the blade.
10) The antikickback fingers prevent the blade from kicking back pieces of wood.
11) The fence holds the wood in place for cutting.
12) The table provides the work area.

2. Safe Adjustment and Operation Procedures for a Radial Arm Saw

a. Obtain permission from your instructor before using the radial arm saw.
b. Use only saw blades that are sharp and properly set.
c. During setup, make sure the blade is tightly fastened to the shaft with its bottom teeth pointing away from the operator and able to spin freely.
d. Make sure the guards and kickback fingers are in place and use them whenever possible.
e. Adjust the blade so it penetrates 1/16 inch below the surface of the table.
f. Make sure the adjustment knobs and levers are tight and the carriage lock released.
g. Hold the wood to be cut firmly on the table and against the fence, making sure the ends of long boards are supported even with the table.

h. Keep a 6-inch margin of safety between your hand and the blade, and keep your arms parallel to the line of cut while holding the wood.
i. Before starting the motor, make sure the blade is clear of the wood, and before cutting allow it to accelerate to full speed.
j. Never force the saw or cut too fast, because this may bind the blade.
k. Since the direction of the teeth pull the blade into the cut, it may be necessary to apply back pressure against the handle to control the speed of the cut.
l. When crosscutting, always pull the blade towards you and return the saw to the rear of the table after completing the cut.
m. When ripping, always feed the wood into the blade from the side where the bottom teeth are pointing towards you.
n. Stop and disconnect the saw before making adjustments.
o. After finishing a cut, do not leave the saw until the blade has completely stopped.

ACTIVITY:

1. Take a safety test for each power tool.
2. Change blades and adjust the power tools.
3. Operate the power tools correctly and safely to cut lumber and wood panels for an ongoing wood project, such as a toolbox or sawhorse.

FASTENING WOOD JOINTS

A. Basic Wood Joints

1. Butt Joints

a. Butt joints are formed by joining two boards end to end, or edge to edge (in line or at a right angle).
b. Butt joints can be reinforced by fastening thin wood or metal gussets to the corners or across the flat surfaces where the boards join.

2. Lap Joints

a. Lap joints, which are stronger than butt joints, are formed by joining two boards face to face.
b. Lap joints can be strengthened by offsetting the boards so they fit into each other.

3. Dado Joints

a. A dado is a rectangular groove cut into a board.
b. Dado joints are formed by inserting the end or edge of another board into this groove.

4. Rabbet Joints

a. A rabbet is a rectangular groove cut in the end or edge of a board.
b. Rabbet joints are formed by inserting the end or edge of another board into this groove.

5. Miter Joints

a. Miter joints formed by cutting the ends of two boards at a 45 degree angle and joining them together to form a 90 degree angle.
b. Miter joints are usually (depending on the grain direction at the joint) stronger than butt joints because they provide more surface contact at the joint.

B. Fastening Wood Joints with Nails

1. Hammers

a. Two types of hammers are commonly used.

1) The curved claw hammer is the most common; it is designed for pulling nails.
2) The ripping claw hammer has a straight claw which can be driven like a chisel between two fastened boards to pry them apart.

b. In order the claw hammer's size is indicated by the weight of its head, which ranges from 7 oz. to 20 oz.

1) A general purpose claw hammer usually comes in the 13 oz. size.
2) Framing hammers used by carpenters usually come in either the 16 oz. or 20 oz. size.

2. Driving Nails

a. In order to drive a nail, the following steps should be performed:

1) To start the nail, hold it between the thumb and index finger and place its point on the desired spot.
2) To avoid smashing the fingers if the hammer accidentally hits them, place them high on the nail to allow them to be knocked free rather than against the wood.
3) To prevent splitting a dry or thin board when driving the nail, use a smaller nail, or blunt the tip of a chisel-shaped nail; if using small nails, cut them off square.
4) Grasp the hammer near the end of the handle with the free hand, and keeping your eyes focused on the nail head, tap the nail one or two times with the hammer until it stands on its own.
5) Use the weight of the hammer to drive the nail, using mostly wrist action for light driving; combine wrist action that with elbow action for heavier driving; combine both wrist and elbow action with shoulder action for very heavy driving.
6) Continue to drive the nail until its head is flush with the surface and the two pieces of wood are tightly fastened; careful not to leave a hammer mark with the final blow.

b. The type of nailing is determined by the kind of joint and by the wood thickness.

1) In flat nailing, nails are driven at a right angle through two flat boards and bent over (clinched) flush with the wood.
2) In end nailing, nails are driven through the thickness of one board and into the end with the grain of another.
3) In toe nailing, nails are driven at an angle near the end of one board into the face of the other when two large pieces of lumber must be fastened at right angles.

c. A nailed joint's strength depends on the location and spacing of the nails.

1) Stagger the nails if possible.
2) Allow adequate separation between nails.
3) Do not drive nails in line with the grain.

3. Pulling Nails

a. If the nail head extends above the surface of the wood, slip the hammer's claws under it.
b. If the nail head is flush with the surface of the wood, use a pair of pincers or cloven nail pulling tool to extend the head far enough for the hammer claws to slip under it.
c. Pull the handle of the hammer until it is perpendicular to the surface, then stop.
d. Place a block of wood under the head of the hammer, and then continue to pull on the handle until the nail is removed.

C. Fastening Wood Joints with Screws

1. Measure the thickness of the boards to be joined.
2. Select a screw length that is three times as long as the thickness of the board being joined unless the screw extends through the second board; in that case, use a shorter screw.
3. Properly space and mark the screw locations.
4. Select a screw diameter that looks in balance with the spacing, closer screws being smaller in diameter.
5. Using a chart, determine the drill size for the shank and pilot holes.
6. Install the pilot hole bit into a hand drill or power drill and adjust the length of the exposed bit to equal the length of the screw.
7. Hold or clamp the two boards together and drill the pilot hole through both boards.
8. Install the shank hole bit into a hand drill or power drill, and use it to enlarge the hole in the first board so that the screw can move freely through it.
9. If a flathead screw is being used, use a countershink tool to make a countersink in the enlarged hole that fits the screw head.
10. Using a screwdriver or screw bit that fits the slot, turn the screw until the two boards are fastened together snugly, but do not over tighten the screw.

D. Fastening Wood Joints with Bolts

1. Select the type of bolt required, usually a carriage bolt since it is designed especially for wood.
2. Select the diameter and length of bolt required.
3. Hold the two boards together and drill a hole through them the same diameter as the bolt.
4. If a machine bolt is being used instead of a carriage bolt, place a flat washer on it, and then insert the bolt in the hole.
5. Place a flat washer on the threaded end of the bolt; a lock washer is often not necessary since the wood provides back pressure on the nut.
6. Place a nut on the bolt and turn it until the boards are joined tightly, but not so tight as to crush the wood fibers or draw the bolt below the surface.

E. Fastening Wood Joints with Glue (White Polyvinyl or Yellow Aliphatic)

1. Make sure the mating surfaces of the two boards to be glued have a good fit and are free of dirt, paint, grease, or wax.
2. Drill the screw or bolt holes if required, and adjust the clamps to fit the boards.
3. Apply small beads of glue on both boards' mating surfaces.
4. Spread the beads of glue out evenly over the mating surfaces.
5. Join the two boards together, and secure them by nails, screws, bolts, or clamps.
6. Check to make sure the joint is properly aligned, and retighten the clamps if used.
7. Using a putty knife or wood chisel, remove the glue runs after they have partially dried.
8. Wipe the glue marks with a clean wet rag, and then wipe them again with a clean dry rag.
9. The clamps can be taken off after 30 minutes, but a stronger bond can be obtained by leaving the clamps on at least 12 hours.

ACTIVITY:

1. Cut and assemble two of the basic wood joints.
2. Practice driving and pulling nails.
3. Fasten wood joints with nails, screws, bolts and glue.
4. Assemble and fasten the pieces of an ongoing woodworking project such as a toolbox or sawhorse. (See Projects Section)

130H-31

Name_____
Date_____
Score_____

WOODWORKING, UNIT EXAM

A. True and False

1. _____ The working edge or surface is the main edge or surface from which the other surfaces are measured or squared.

2. _____ A crosscut hand saw cuts the wood during the back stroke.

3. _____ Miter joints are stronger than butt joints because they provide more surface contact at the joint.

4. _____ The teeth of a crosscut circular saw blade should point towards you when cutting wood.

5. _____ Nailing is the quickest and weakest method of fastening wood.

6. _____ S4S is lumber surfaced on four sides.

7. _____ The actual size of S4S dimension lumber is 1/4 inch less than the nominal size.

8. _____ Lumber graded as common no. 1, 2, and 3 is suitable for use without waste.

9. _____ Lumber graded as select C or D is suitable for natural finishes.

10. _____ G2S means the veneer of a plywood panel is good on two sides.

11. _____ Good economical construction requires the proper use of the lowest grade lumber suitable for the purpose.

12. _____ File teeth cut only on the forward stroke.

13. _____ A dull circular saw blade is more dangerous than a sharp one.

14. _____ The table saw's primary purpose is to make crosscuts in wood.

15. _____ The thickness of a table saw or radial arm saw's saw cut is 1/8 inch.

B. Matching

1. _____ Perpendicular to the plane of the horizon or in line with gravity.

2. _____ Parallel to the plane of the horizon or having the same height everywhere.

3. _____ Objects positioned so that their edges, surfaces, or ends are even.

4. _____ Lines, surfaces, or planes positioned at right angles (90 degrees) to one another.

5. _____ A sloping edge (less than 90 degrees).

6. _____ Needle-leaf, evergreen trees (conifers).

7. _____ Broad-leaf, deciduous trees.

8. _____ Lumber used for posts, beams, and heavy stringers.

9. _____ Lumber used for sills, plates, studs, rafters, and other framing members.

10. _____ Lumber used for flooring, sheathing, paneling, and trim.

11. _____ Lumber of good appearance and finishing qualities.

12. _____ Lumber containing defects and blemishes.

13. _____ A hand tool used to shave wood to obtain a smooth surface.

14. _____ A crank handle used to turn an auger bit.

15. _____ A tool with gears designed to turn a bit much faster than its handle turns.

16. _____ The stationary saw used primarily for crosscutting lumber.

17. _____ The stationary saw used primarily for ripping lumber.

18. _____ An automatic drill used for rapidly drilling holes up to 3/16 inch.

19. _____ A rectangular groove cut into wood.

20. _____ A joint made by joining to boards face-to-face.

a. Square
b. Soft Wood
c. Level
d. Timbers
e. Common
f. Push Drill
g. Plumb
h. Plane
i. Flush
j. Hand Drill
k. Dado
l. Bevel
m. Dimension
n. Table
o. Boards
p. Lap
q. Bit Brace
r. Hard Wood
s. Select
t. Radial Arm

C. Multiple Choice

1. Which function can a combination square not perform?

a. Measure distances up to 12 inches.
b. Serve as a guide to mark 30 degree angles.
c. Serve as a guide to draw 45 degree angles.
d. Serve as a marking gauge for marking lines parallel to the edge of a board.

2. Which is the strongest type of nailing?

a. Flat nailing.
b. End nailing.
c. Toe nailing.
d. None of the above.

3. Which of the trees below is a hardwood?

a. Spruce
b. Oak
c. Cedar
d. Redwood

4. Which of the trees below is used primarily for framing lumber?

a. Birch
b. White pine
c. Yellow pine
d. Fir

5. Which wood panel is the most dense?

a. Plywood
b. Hardboard
c. Particle board
d. Wafferboard

6. Which of these terms does not refer to the same relationship?

a. Perpendicular
b. 90 degrees
c. Level
d. Right angle

7. Which hand saw is held at a 60 degree angle to the surface of the wood it is cutting?

    a. Crosscut saw
    b. Rip saw
    c. Back saw
    d. Coping saw

8. Which hand saw is used with a miter box?

    a. Rip saw
    b. Coping saw
    c. Keyhole saw
    d. Back saw

9. Which hand tool is used to shave wood in recessed areas?

    a. Plane
    b. Chisel
    c. File
    d. None of the above

10. The blade of a portable circular saw should extend through the wood being cut at least:

    a. 1/16 inch
    b. 1/8 inch
    c. 1/2 inch
    d. 3/4 inch

Answer Sheet

A. True and False

1. T
2. F
3. T
4. F
5. T
6. T
7. F
8. T
9. F
10. T
11. T
12. T
13. T
14. F
15. T

B. Matching

1. G
2. C
3. I
4. A
5. L
6. B
7. R
8. D
9. M
10. O
11. S
12. E
13. H
14. Q
15. J
16. T
17. N
18. F
19. K
20. P

C. Multiple Choice

1. B
2. C
3. B
4. D
5. B
6. C
7. B
8. D
9. B
10. B

References:

Wagner, W. H. (1987). MODERN CARPENTRY. South Holland, IL: Goodheart Willcox.

Cooper, Elmer L. (1997). AGRICULTURAL MECHANICS: FUNDAMENTALS AND APPLICATIONS, 3ed EDITION. Albany, NY: Delmar Publishers.

Jones, M. M. (1955). SHOPWORK ON THE FARM. New York: McGraw-Hill.

Phipps, Lloyd J., and Miller, Glen M.(1998) AGRISCIENCE MECHANICS. Danville, IL: Interstate Publishing

Burke, Stanley R., and Wakeman, T. J. (1990) MODERN AGRICULTURAL MECHANICS, 2ed EDITION. Danville, IL: Interstate Publishing

Special Material and Equipment:

Samples of different kinds of wood and grades of lumber and plywood.
A measuring tape, combination square, carpenter's square, bevel square, level, chalk line, plumb line & bob, sharp pencil, and boards to be marked
Crosscut saw, rip saw, coping saw, compass saw, keyhole saw, bit brace, auger bits, hand drill, push drill, a plane, chisels, files, boards to cut
Portable circular saw, stationary circular saw, radial arm saw
13 oz. curved claw hammer, 16- and 20-oz. ripping claw hammers, various nails, screws, bolts, white polyvinyl glue, clamps, clean rags, standard & Phillips screwdrivers, wrenches, scrap wood

SEE SECTION 130Y FOR WOODWORKING PROJECTS